BAKER BOTTS LLP

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35.U.S.C. 371

EXPRESS MAIL LABEL No.	DATE
EF377398953US	9 JANUARY 2002

ATTORNEY'S DOCKET NO.: A34921 PCT USA

U.S. APPLICATION NO.: 10/030532

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/02257	12 JULY 2000	12 JULY 1999

TITLE OF INVENTION: HANDLING SYSTEM

APPLICANT(S) FOR DO/EO/US: Rolf Hartung

Applicant herewith submits to the United States Designated /Elected Office (DO/EO/US) the following items and other information:

1. ✔ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. ✔ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(I).
4. [ ] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ✔ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ✔ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ✔ A copy of the International Search Report (PCT/ISA/210)
   a. ✔ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been transmitted by the International Bureau
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ✔ A copy of the International Preliminary Examination Report (PCT/IPEA/409)
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [ ] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. ✔ Other items or information:
    a. [ ] a copy of the International Search Report (PCT/ISA/210)
    b. [ ] a copy of the International Preliminary Examination Report (PCT/IPEA/409)

Also:
International Application WO 01/04932 A1 (incl. 9 pages spec, 3 pages claims, 2 sheets drawings)
PCT Form PCT/IB/332
Amended specification and claims

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/02257	12 JULY 2000	12 JULY 1999

17. ☑ The following fees are submitted:

CALCULATIONS PTO USE ONLY

Basic National Fee (37 CFR 1.492(a)(1)-(5):

Neither international preliminary examination fee (37 CFR 1.482)
Nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO (1.492(a)(3)) $1,040

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO (1.492(a)(5) $890.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO(1.492(a)(2)) $740.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) (1.492(a)(1)) $710.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) $ 100.00

ENTER APPROPRIATE BASIC FEE AMOUNT				=	$ 890
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 C.F.R. 1.492(e)).					$
Claims	**Number Filed**	**Number Extra**	**Rate**		$
Total Claims	-20=	0	X $ 18.00		$ 0
Independent Claims	-3=	0	X $ 84.00		$ 0
Multiple dependent claim(s) (if applicable)			+ $280.00		$
TOTAL OF ABOVE CALCULATIONS				=	$ 890
Reduction by ½ for filing by small entity, if applicable.					$ 445
SUBTOTAL				=	$ 445
Processing fee of $130.00 for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				+	$
TOTAL NATIONAL FEE				=	$ 445
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property				+	$
TOTAL FEES ENCLOSED				=	$ 445
					Amt. refunded $
					charged $

a. ☑ A check in the amount of $ 445 to cover the above fees is enclosed.

b. [ ] Please charge our Deposit Account No. 02-4377 in amount of $_____ to cover the above fees. A copy of this sheet is enclosed.

c. ☑ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-4377. A copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
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Attorney: James J. Maune PTO Reg: 26,946

9 JANUARY 2002
Date

BAKER BOTTS LLP

Attorney Docket Number: A34921 PCT USA

Title: HANDLING SYSTEM

Use Space Below for Additional Information:

CERTIFICATION UNDER 37 C.F.R. 1.8(a) OR 1.10*

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37 C.F.R. 1.8(a)

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Date: January 9, 2002

37 C.F.R. 1.10*

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Signature

James J. Maune

(type or print name of person certifying)

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#4

FILE NO.A34921-PCT-USA-066340.0140

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Hartung		
Serial No.	:	10/030,532	Examiner	:
Filed	:	January 9, 2002	Group Art Unit:	
For	:	HANDLING SYSTEM		

PRELIMINARY AMENDMENT AND
RESPONSE TO NOTICE TO FILE MISSING PARTS

I hereby certify that this paper is being deposited with the United States Postal Service in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231

May 15, 2002
Date of Deposit

James J. Maune
Attorney Name

26,946
PTO Registration No

Signature

May 15, 2002
Date of Signature

Assistant Commissioner for Patents

Washington, D.C. 20231

Sir:

In response to the Notice to File Missing Parts Applicants submit herewith a translation of the application as filed.

Please amend the Application as follows:

IN THE SPECIFICATION:

Please substitute the attached Substitute Specification and Abstract for the translation of this application. The Substitute Specification conforms to U.S. Practice and places the application in better English.

IN THE CLAIMS:

Cancel Claims 1 to 16.

Add claims 17 to 31 as follows:

17. (New) Apparatus for handling wafers to place said wafers in a chamber having a wafer holding device including a cooling plate and a heating plate, wherein said wafers are provided for processing in said chamber in a wafer cassette, comprising:

an external handling device having grippers for transferring said wafers between said cassette and said chamber; and

an internal handling device provided in a cooled area of said chamber, said internal handling device having at least one fork arranged to move with at least two degrees of freedom and arranged to interact with said grippers of said external handling device to receive a wafer therefrom, said fork being arranged to move said wafers between said cooling plate and said heating plate.

18. (New) Apparatus as specified in claim 17 wherein said fork is arranged to be move under a placement location for said wafers on said wafer holding device.

19. (New) Apparatus as specified in claim 17 wherein said heating plate and said cooling plate are arranged next to one another in said chamber.

20. (New) Apparatus as specified in claim 19 wherein said heating plate and said cooling plate are arranged one behind the other in said chamber.

21. (New) Apparatus as specified in claim 17 wherein there is provided a cooling device for cooling said internal handling device.

22. (New) Apparatus as specified in any of claims 17 through 21 wherein there are provided multiple heating and cooling plates arranged in a stack in said chamber.

23. (New) Apparatus as specified in claim 22 wherein said internal and external handling devices are arranged to load wafers on said plate sequentially.

24. (New) Apparatus as specified in claim 22 wherein said internal and external handling devices are arranged to load wafers on said plate simultaneously.

25. (New) Apparatus as specified in claim 17 wherein said fork is arranged to be preheated.

26. (New) Apparatus as specified in claim 25 wherein said fork is arranged to contact said heating plate for said preheating.

27. (New) Apparatus as specified in claim 17 wherein there is provided an additional internal handling device.

28. (New) Apparatus as specified in claim 17 wherein there are provided multiple chambers arranged in a stack.

29. (New) Apparatus as specified in claim 17 wherein said chamber has first and second openings and wherein there are provided two of said external handing devices, one for transferring wafers through each of said openings.

30. (New) Apparatus as specified in claim 17 wherein said chamber and said external handling device are surrounded by an enclosure.

31. (New) Apparatus as specified in claim 30 wherein said enclosure is purged by gas at a low overpressure.

FILE NO.A34921-PCT-USA-066340.0140

PATENT

REMARKS

Applicants submit herewith a translation of the application as filed and a proposed Substitute Specification and Abstract in compliance with U.S. Practice.

Claims 1 to 16 are cancelled. Claims 17 to 31 conforming to U.S. practice are presented.

A Declaration and Power of Attorney are submitted herewith.

Respectfully submitted,

James J. Maune
PTO Reg. No. 26,946
Attorney for Applicant
(212) 408-2566

FILE NO. A34921-PCT-USA-066340.0140

BAKER BOTTS L.L.P.

30 ROCKEFELLER PLAZA

NEW YORK, NEW YORK 10112

TO ALL WHOM IT MAY CONCERN:

Be it known that I, Rolf Hartung, , a citizen of Germany, have invented an improvement in:

HANDLING SYSTEM

of which the following is a

SUBSTITUTE SPECIFICATION

SPECIFICATION

BACKGROUND OF INVENTION

[0001] The invention relates to a handling system for receiving and handling a product, which has been transferred from a cassette by a handler, and for providing the product to a processing station.

[0002] The invention is particularly useful for handling wafers, such as semiconductor wafers, that are to be subjected to heat treatment in a processing station, such as a vacuum chamber, to perform processes such as a vacuum soldering or wafer bumping in a wafer bumping device which includes a vacuum chamber. To this end, it is necessary to remove the wafers from a transport container and to transport them into the vacuum chamber by means of a suitable handling device. However, this means that the vacuum chamber must be opened, i.e. standard pressure must first be established in the vacuum chamber, which involves a simultaneous loss of heat and change in the atmosphere in the vacuum chamber. Consequently after loading with one or more wafers, the vacuum chamber must be flushed and the desired gas composition must be

established, for example by the introduction of an inert gas or a process gas, and at the same time, the requisite vacuum for the particular processing step must be reestablished. In addition, the wafers must be heated to the necessary process temperature.

[0003] After completion of the processing step in the vacuum chamber, it is necessary to cool the wafers evenly to a temperature in the vicinity of room temperature prior to their removal in order to avoid thermal shock upon removal from the vacuum chamber resulting from a possible extreme cooling rate (high temperature gradient).

[0004] Consequently, it is desirable that handling of the wafers, in particular transport of the wafers into the processing station and removal of the wafers from the processing station, can be accomplished as simply and rapidly as possible by a suitable handling system.

[0005] The object of the invention is thus to create a handling system that permits secure and rapid handling of the product and that has, in particular, a long service life and is subjected to low mechanical and thermal stress.

SUMMARY OF THE INVENTION

[0006] This object of the invention is achieved in a handling system of the aforementioned type in that there is provided in the processing station an internal handling system having at least one fork that can be moved with several degrees of freedom and that interacts with grippers of an external handling system so that the product (wafers) transported into the vacuum chamber by the external handling system can be received by the fork and placed by the same on a holding device.

[0007] In this way, a simple division into an internal and an external handling system is achieved so that the processing step can be completely isolated within the processing station, and the processing chamber need only be opened briefly for removal and reloading.

[0008] In a further development of the invention, the fork of the internal handling system can be moved under the placement location of the wafer on the holding device. Simple handling of the wafer is thus achieved in that it is merely lifted from underneath by the fork without additional mechanical aids and transported to the next placement location.

[0009] A further embodiment of the invention is characterized in that the holding device in the processing chamber has at least one cooling plate and at least one heating plate. In this way, the wafer can be heated inside the processing chamber (vacuum chamber) to the processing temperature required for the relevant processing step, and can be cooled to a temperature suitable for removal from the processing chamber after completion of the processing step by transfer to the cooling plate. The open time of the processing chamber can thus be further reduced.

[0010] The cooling plate and the heating plate can be arranged next to one another or one behind the other.

[0011] Another special embodiment of the invention is characterized in that the internal handling system consists of a transverse guide upon which the fork is supported in a mount, such that it can move vertically and laterally, and is located behind the plates.

[0012] Preferably the internal handling device is accommodated in a cooled area of the processing chamber and/or is associated with a cooling device for temperature control.

[0013] In another special refinement of the invention, instead of the use of two adjacent plates in the holding device, a multiple arrangement is provided in that multiple cooling and heating plates are arranged in a stack. For example, the multiple arrangement can consist of 12 or 24 layers in a stack that can be loaded sequentially or simultaneously.

[0014] In an advantageous variant of the invention, the fork of the internal handling system can be preheated so that the wafer to be removed from the heating plate can be removed without first having to be cooled.

[0015] Heating of the fork can advantageously be achieved by bringing it into contact with the heating plate for a long enough time before removal of a wafer that a predetermined temperature is reached.

[0016] In a further advantageous development of the invention, an additional handling system is installed opposite the handling system.

[0017] In addition, multiple processing chambers can be stacked on top of one another and/or next to one another.

[0018] In order to facilitate a continuous process flow, an additional option for removal of the wafers can be provided through a rear wall of the chamber, by providing the rear wall of the processing chamber with a closable opening that is associated with a second handling system (handler) or another transport system.

[0019] In order to prevent the entry of dust into the processing chamber, a covering may be provided surrounding the chamber and the transfer area of the transport magazine for wafers to

achieve a dust-free area. This area within the covering can advantageously be purged with hydrogen/nitrogen gas at low overpressure.

[0020] The invention is explained in detail below using an example embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Fig. 1 is a simplified representation of a processing chamber in accordance with an embodiment of the invention with an internal handling system; and

[0022] Fig. 2 is a simplified perspective view of the structure of the internal handling system of Figure 1.

DESCRIPTION OF THE INVENTION

[0023] The product to be handled, for example in the present case a 300 mm wafer, is placed on a conventional loading station 1 in a special cassette. An external handling device 2, which is located under a cover 3, removes the waver 4 from the special cassette through the port 5 using grippers and, while processing chamber 6 is open, transports it onto a cooling plate 7 located therein that is part of a holding device which includes the cooling plate 7 and a heating plate 8. From this cooling plate 7, grippers (not shown) of the holding device accept the wafer 4 and hold it at a predetermined height until the external handling device 2 is retracted and the processing chamber 6 is closed.

[0024] The processing step now begins in the processing chamber 6 (e.g. a vacuum chamber or vacuum oven), in that an internal handling device 9 accepts the wafer 4 from the gripper of the holding device by means of a fork 10. The wafer 4 is transported over the heating plate 8 by the

fork 10 and is lowered onto another holding device associated with this heating plate 8. In this process, the fork 10 is lowered slightly and moved back to an advantageous waiting position.

[0025] The cooling plate 7 and the heating plate 8 are arranged next to one another in the processing chamber 6, as is shown schematically in Fig. 2. Located behind the plates 7, 8 is the internal handling system 9 with a transverse guide 11 upon which the fork 10 is supported in a mount 12 such that it can move vertically and laterally.

[0026] At the end of the thermal treatment performed over the heating plate 7, the wafer 4 is lifted with the holding device. The fork 10 now moves back under the wafer 4 and accepts it. The internal handling device 9 transports the wafer 4 over the cooling plate 7 and lowers it until it contacts the cooling plate 7. Once a predetermined temperature is reached, the processing chamber 6 is opened. The gripper 13 (shown schematically) of the external handling device 2 removes the wafer 4 and transports it back into the transport cassette.

[0027] The process can then be repeated with a new wafer 4.

[0028] It is important for the function of the internal handling device 9 that it is accommodated in a cooled area of the processing chamber 6. A cooling device for temperature control can be associated with the internal handling device 9.

[0029] Instead of using two adjacent plates 7, 8, it is also possible to provide a multiple arrangement in that multiple cooling and heating plates 7, 8 are arranged one above the other in several layers. In this way it is possible to provide 12 or 24 layers one above the other.

[0030] It is possible to load the layers sequentially or simultaneously, which leads to a significant reduction in the cycle time.

[0031] In a variant, the plates 7, 8, rather than being next to one another (Fig. 2), can be one behind the other, so that the cooling plates 7 are located in front of the heating plates 8. This would have the advantage of a staggering of temperature as seen over the depth of the processing chamber 6. In other words, the cooler region is in front, hence in the transfer area from the external handling device 2 to the internal handling device 5.

[0032] In order to prevent thermal shock when transferring a heated wafer following heat treatment in the processing chamber 6, the fork 10 is preheated. Preheating can be accomplished in that the fork 10 is placed in contact with the heating plate 8 long enough to reach a desired temperature before transferring a wafer.

[0033] Furthermore, it is possible to install an additional handling device opposite the internal handling device 9, or to stack multiple processing chambers 6 on top of and/or next to one another.

[0034] In a special variant of the invention, an additional option for removal of the product (wafers 4) is provided through the rear wall 14 of the processing chamber 6. Removal can be accomplished with a second external handling device (handler) or another transport system. In this way a continuous flow method is implemented in that the wafers are transferred from the first external handling device 1 into the processing chamber 2 and, after the specified processing, are removed by the second external handling device. Commercially available devices can be used for the external handling devices (handlers).

[0035] Inside the processing chamber 6, the wafers 4 are automatically transported from a heat source (heating plate 8) to a cooling plate 7. The wafer transport system is comprised of three sections.

[0036] The first section relates to transport within the processing chamber 6. It encompasses the acceptance of the wafers 4 at the chamber entrance, the processing of the wafers 4 within the processing chamber 6, and the return transport of the wafers 4 to the chamber entrance.

[0037] The second section is located in front of the processing chamber 6 and is arranged between the entrance of the processing chamber 6 and the output of the semi standard load port for 300 mm wafers.

[0038] The external handling device 2 (handling system) takes the wafers 4 from this port 5 and transports them into the processing chamber 6.

[0039] At the end of, for example, the wafer bump reflow soldering process in the processing chamber 6, the external handling device 2 takes the wafers 4 and transports them back through the standard load port into the cassette box.

[0040] The third section is located in front of the standard load port; here, the transport cassette (FOUP = Front Opening Unified Pod) and the wafers 4 contained therein can be removed manually or by means of a robot.

[0041] The entire area in which the wafers 4 are moved is protected from environmental influences, so that no particles can penetrate into this area. This area can be flushed with hydrogen/nitrogen at low overpressure.

[0042] While there has been described what are believed to be the preferred embodiment of the invention, those skilled in the art will recognize that other and further modifications may be made thereto without departing from the spirit of the invention, and it is intended to claim all such changes and modifications as fall within the true scope of the invention.

Reference Symbols

1	loading station
2	external handling device
3	cover
4	wafer
5	port
6	processing chamber
7	cooling plate
8	heating plate
9	internal handling device
10	fork
11	transverse guide
12	mount
13	gripper
14	rear wall

ABSTRACT

[0043] A processing chamber for semiconductor wafers is provided with internal and external handling devices. The external handling devices are arranged to transfer wafers from a cassette into the chamber. The internal handling device includes a fork arranged for movement within the chamber and to interact with the external handling device to receive wafers therefrom and to transport the wafers between a heating plate and a cooling plate within the chamber.

Handling System

The invention relates to a handling system for removing wafers provided from a cassette and for transferring the same to a vacuum chamber for heat treatment of the wafers, with an external and an internal handling device, wherein the internal handling device has at least one fork that can be moved with several degrees of freedom and that interacts with grippers of the external handling device. The above-mentioned wafers can be understood to include semiconductor wafers which are to be subjected to heat treatment inside a processing station, for example a vacuum chamber, for example in order to perform a vacuum soldering process or wafer bumping process in a wafer bumping device (wafer bumping equipment) that encompasses the vacuum chamber. To this end, it is necessary to remove the wafers from a transport container (FOUP = Front Open Unified Pot) and to transport them into the vacuum chamber by means of a suitable handling device. However, this means that the vacuum chamber must be opened, i.e. standard pressure must first be established in the vacuum chamber, which involves a simultaneous loss of heat and change in the atmosphere in the vacuum chamber. Consequently after loading with one or more wafers, the vacuum chamber must be flushed and the desired gas composition must be established, for example by introduction of an inert gas or a process gas, and at the same time, the requisite vacuum for the particular processing step must be reestablished. In addition, the wafers must be heated to the necessary process temperature.

After completion of the processing step in the vacuum chamber, it is necessary to cool the wafers evenly to a temperature in the vicinity of room temperature prior to their

removal in order to avoid thermal shock upon removal from the vacuum chamber resulting from a possible extreme cooling rate (high temperature gradient).

Consequently, it is desirable that handling of the wafers, in particular transport of the wafers into the vacuum chamber and removal of the wafers from the vacuum chamber, can be accomplished as simply and rapidly as possible by a suitable handling system.

Thus, a device and a method for treatment of substrates emerge from US-A-5-919-529 which encompass a plurality of transport devices. These transport devices are arranged such that their working areas partially overlap, so that the substrates can be transported through a number of processing stations one after another.

Moreover, US-A-4-816-116 describes a wafer transfer system with which wafers can be transported into a vacuum chamber from outside. To this end there is located within the chamber a rotating transfer arm whose wafer receptacle can be moved outside the chamber. This transfer system is extremely complex mechanically and contains several wear-prone linkages.

Lastly, US-A-5-972-110 describes a transfer system with which wafers can be transported in handling units, wherein there is also described a variant in which the wafers can be transported into the treatment chamber from one side and removed on the opposite side.

The object of the invention is thus to create a handling system that permits secure and rapid handling of the product while avoiding the disadvantages of the prior

art and that has, in particular, a long service life and is subjected to low mechanical and thermal stress.

This object of the invention is achieved in a handling system of the aforementioned type in that the wafers that are transported into the vacuum chamber by the external handling device can be placed on a cooling plate of a holding device consisting of the cooling plate and a heating plate, wherein the fork (10) of the internal handling device (9) can be moved between the heating plate (8) and the cooling plate (7) and interacts with the holding device for the wafers, and in that the internal handling device is accommodated in a cooled area of the vacuum chamber.

In this way, a simple division into an internal and an external handling system is achieved so that the processing step can be completely isolated within the vacuum chamber, and the vacuum chamber need only be opened briefly for removal and reloading.

Moreover, in this way the wafer can be heated inside the vacuum chamber to the processing temperature required for the relevant processing step, and can be cooled to a temperature suitable for removal from the vacuum chamber after completion of the processing step by transfer to the cooling plate. The open time of the vacuum chamber can thus be further shortened.

In a further development of the invention, the fork of the internal handling system can be moved under the placement location of the wafer on the holding device. Simple handling of the wafer is thus achieved in that it is merely lifted from underneath by the fork without additional mechanical aids and transported to the next placement location.

The cooling plate and the heating plate can be arranged next to one another or one behind the other.

Preferably a cooling device for temperature control is associated with the internal handling device.

In another special refinement of the invention, the multiple arrangement can consist of 12 or 24 layers in a stack that can be loaded sequentially or simultaneously (e.g. at one time).

In an advantageous variant of the invention, the fork of the internal handling system can be preheated so that the wafer to be removed from the heating plate can be removed without first having to be cooled.

Heating of the fork can advantageously be achieved in that it is in contact with the heating plate for a long enough time before removal of a wafer that a predetermined temperature is reached.

In a further advantageous development of the invention, an additional handling device is installed opposite the internal handling device.

In addition, multiple vacuum chambers can be stacked on top of one another and/or next to one another.

In order to facilitate a continuous process flow, an additional option for removal of the wafers can be provided through a rear wall of the chamber in that the rear wall of the vacuum chamber is equipped with a closable opening that is associated with a second handling system or another transport system.

In order to prevent the entry of dust into the vacuum chamber, a covering surrounds it and the transfer area of the cassette to achieve a dust-free area . This area

within the covering can advantageously be purged with hydrogen/nitrogen at low overpressure.

The invention is explained in detail below using an example embodiment. The associated figures of the drawings show:

Fig. 1: a schematic representation of a vacuum chamber in accordance with the invention with an internal handling system; and

Fig. 2: the schematic structure of the internal handling system.

The product to be handled, for example in the present case a 300 mm wafer, is placed on a conventional loading station 1 in a special cassette (FOUP). An external handling device 2, which is located under a cover 3, removes the waver 4 from the special cassette through the port 5 and, while vacuum chamber 6 is open, transports it onto a cooling plate 7 located therein that is part of a holding device consisting of the cooling plate 7 and a heating plate 8. From this cooling plate 7, grippers (not shown) of the holding device accept the wafer 4 and hold it at a predetermined height until the external handling device 2 is retracted and the vacuum chamber 6 is closed.

The processing step now begins in the vacuum chamber 6, or vacuum oven, in that an internal handling device 9 accepts the wafer 4 from the gripper of the holding device by means of a fork 10. The wafer 4 is transported over the heating plate 8 by the fork 10 and is lowered onto an additional holding device associated with this heating plate 8. In this process, the fork 10 is lowered slightly and moved back to an advantageous waiting position.

The cooling plate 7 and the heating plate 8 are arranged next to one another in the vacuum chamber 6, as is shown schematically in Fig. 2. Located behind the plates 7, 8 is the internal handling system 9 with a transverse guide 11 upon which the fork 10 is supported in a mount 12 such that it can move vertically and laterally.

At the end of the thermal treatment performed over the heating plate 7, the wafer 4 is lifted with the holding device. The fork 10 now moves back under the wafer 4 and accepts it. The internal handling device 9 transports the wafer 4 over the cooling plate 7 and lowers it until it contacts the cooling plate 7. Once a predetermined temperature is reached, the vacuum chamber 6 is opened. The gripper 13 (shown schematically) of the external handling device 2 removes the wafer 4 and transports it back into the transport cassette (FOUP).

The process can then be repeated with a new wafer 4.

It is important for the function of the internal handling device 9 that it is accommodated in a cooled area of the vacuum chamber 6. A cooling device for temperature control can be associated with the internal handling device 9.

Instead of using two adjacent plates 7, 8, it is also possible to provide a multiple arrangement in that multiple cooling and heating plates 7, 8 are arranged one above the other in several layers. In this way it is possible to provide 12 or 24 layers one above the other.

It is possible to load the layers sequentially or simultaneously (e.g. at one time), which leads to a significant reduction in the cycle time.

In a variant, the plates 7, 8, rather than being next to one another (Fig. 2), can be one behind the other, so that the cooling plates 7 are located in front of the heating

plates 8. This would have the advantage of a staggering of temperature as seen over the depth of the vacuum chamber 6. In other words, the cooler region is in front, hence in the transfer area from the external handling device 2 to the internal handling device 5.

In order to prevent thermal shock when transferring a heated wafer following heat treatment in the vacuum chamber 6, the fork 10 is preheated. Preheating can be accomplished in that the fork 10 is placed in contact with the heating plate 8 long enough to reach a desired temperature before transferring a wafer.

Furthermore, it is possible to install an additional handling device opposite the internal handling device 9, or to stack multiple vacuum chambers 6 on top of and/or next to one another.

In a special variant of the invention, an additional option for removal of the product (wafers 4) is provided through the rear wall 14 of the vacuum chamber 6. Removal can be accomplished with a second external handling device or another transport system. In this way a continuous flow method is implemented in that the wafers are transferred from the first external handling device 1 into the vacuum chamber 2 and, after the specified processing, are removed by the second external handling device. Commercially available devices can be used for the external handling devices.

Inside the vacuum chamber 6, the wafers 4 are automatically transported from a heat source (heating plate 8) to a cooling plate 7. The wafer transport system is comprised of three sections.

The first section relates to transport within the vacuum chamber 6. It encompasses the acceptance of the wafers 4 at the chamber entrance, the processing

of the wafers 4 within the processing chamber 6, and the return transport of the wafers 4 to the chamber entrance.

The second section is located in front of the vacuum chamber 6 and is arranged between the entrance of the vacuum chamber 6 and the output of the semi standard load port for 300 mm wafers.

The external handling device 2 (handling system) takes the wafers 4 from this port 5 and transports them into the vacuum chamber 6.

At the end of, for example, the wafer bump reflow soldering process in the vacuum chamber 6, the external handling device 2 takes the wafers 4 and transports them back through the standard load port into the FOUP box.

The third section is located in front of the standard load port; here, the transport cassette (FOUP = Front Opening Unified Pod) and the wafers 4 contained therein can be removed manually or by means of a robot.

The entire area in which the wafers 4 are moved is protected from environmental influences, so that no particles can penetrate into this area. This area can be flushed with hydrogen/nitrogen at low overpressure.

Reference Symbols

1	loading station
2	external handling device
3	cover
4	wafer
5	port
6	vacuum chamber
7	cooling plate
8	heating plate
9	internal handling device
10	fork
11	transverse guide
12	mount
13	gripper
14	rear wall

Claims

1. Handling system for removing wafers (4) provided from a cassette and for transferring the same to a vacuum chamber (6) for heat treatment of the wafer (4), with an external and an internal handling device (2, 9), wherein the internal handling device (9) has at least one fork (10) that can be moved with several degrees of freedom and that interacts with grippers (13) of the external handling device (2), **characterized in that** the wafers (4) that are transported into the vacuum chamber (6) by the external handling device (2) can be placed on a cooling plate (7) of a holding device consisting of the cooling plate (7) and a heating plate (8), wherein the fork (10) of the internal handling device (9) can be moved between the heating plate (8) and the cooling plate (7) and interacts with the holding device for the wafers (4), and in that the internal handling device (9) is accommodated in a cooled area of the vacuum chamber (6).

2. Handling system in accordance with claim 1, **characterized in that** the fork (10) can be moved under the placement location of the wafer (4) on the holding device.

3. Handling system in accordance with claim 1, **characterized in that** the cooling plate (7) and the heating plate (8) are arranged next to one another.

4. Handling system in accordance with claim 1, **characterized in that** the cooling plate (7) and the heating plate (8) are arranged one behind the other.

5. Handling system in accordance with claim 1, **characterized in that** the internal handling device (9) is associated with a cooling device for temperature control.

6. Handling system in accordance with one of claims 1 through 5, **characterized in that** instead of the use of two adjacent plates (7), a multiple arrangement is provided in that multiple cooling and heating plates (7, 8) are arranged in a stack.

7. Handling system in accordance with claim 1, **characterized in that** the multiple arrangement can consist of 12 or 24 layers in a stack.

8. Handling system in accordance with claim 7, **characterized in that** the layers can be loaded sequentially or simultaneously (e.g. at one time).

9. Handling system in accordance with claims 1 ad 2, **characterized in that** the fork (10) can be preheated.

10. Handling system in accordance with claim 9, **characterized in that** the fork (10) is in contact with the heating plate (7) for a long enough time that a predetermined temperature is reached before removal of a wafer (4).

11. Handling system in accordance with one of claims 1 to 10, **characterized in that** an additional handling device is installed opposite the internal handling device (9).

12. Handling system in accordance with one of claims 1 to 11, **characterized in that** multiple vacuum chambers (6) are stacked on top of one another and/or next to one another.

13. Handling system in accordance with one of claims 1 to 12, **characterized in that** an option for removal of the product (wafer) is provided through the rear wall (14) of the vacuum chamber (6).

14. Handling system in accordance with claim 13, **characterized in that** the rear wall (14) of the vacuum chamber (6) is equipped with a closable opening that is associated with a second external handling device or another transport system.

15. Handling system in accordance with one of claims 1 to 14, **characterized in that** the vacuum chamber (6) and the transfer area of the cassette are surrounded by a common covering (3) to achieve a dust-free area.

16. Handling system in accordance with claim 15, **characterized in that** the area within the covering (3) is purged with hydrogen/nitrogen at low overpressure.

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

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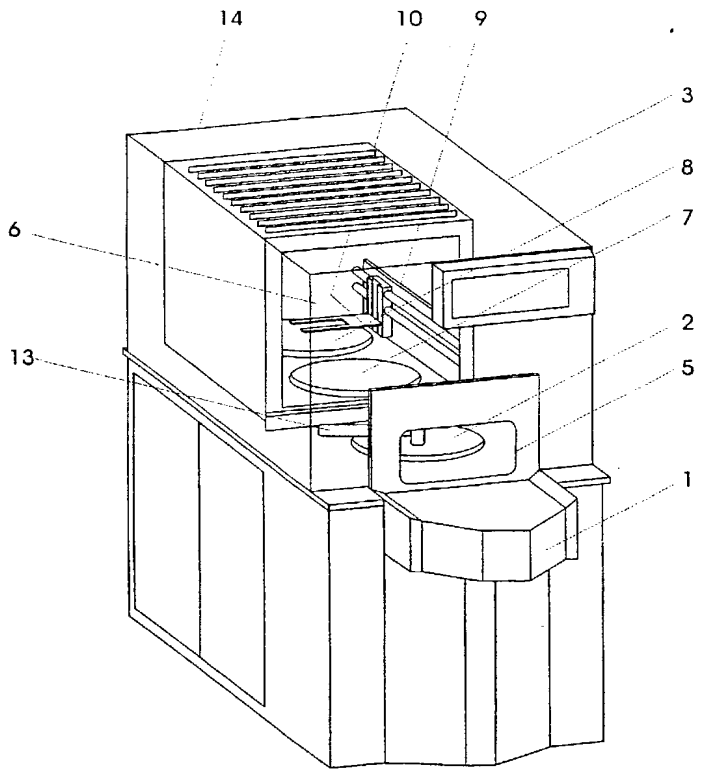
[Fortsetzung auf der nächsten Seite]

(54) Title: HANDLING SYSTEM

(54) Bezeichnung: HANDHABUNGSSYSTEM



(57) Abstract: The invention relates to a handling system for removing a product from a cassette which has been placed in said cassette by a handling device and for transferring the same to a processing station. The invention aims to provide a handling system which enables secure and rapid handling of the product, which has, in particular, a long serviceable life and which is subjected to low mechanical and thermal stress. According to the invention, an internal handling device (9) with a fork (10) that can be displaced with varying degrees of freedom is provided in the processing chamber (6). Said fork interacts with gripping elements (13) of an external handling system (2) in such a way, that the product which is conveyed into the processing chamber (6) by the external handling system (2) can be received by the fork (10) and can be placed by the same onto a holding device.

(57) Zusammenfassung: Die Erfindung betrifft ein Handhabungssystem zur Übernahme einer von einem Handler aus einer Kassette bereitgestellten Ware aus einer Kassette und zur Übergabe derselben an eine Bearbeitungsstation. Durch die Erfindung soll ein Handhabungssystem geschaffen werden, mit dem eine sichere und schnelle Handhabung der Ware ermöglicht wird und das insbesondere eine lange Nutzungsdauer bei geringer mechanischer und thermischer Beanspruchung aufweist. Erfindungsgemäss ist in der Bearbeitungskammer (6) eine interne Handhabungsvorrichtung (9) vorgesehen, die wenigstens eine in mehreren Freiheitsgraden verfahrbare Gabel (10) aufweist, die mit Greifern (13) eines externen Handhabungssystemes

[Fortsetzung auf der nächsten Seite]

WO 01/04932 A1

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Application Number	10/030,532
Filing Date	JANUARY 9, 2002
First Named Inventor	ROLF HARTUNG
Group Art Unit	
Examiner Name	
Attorney Docket Number	A34921 PCT USA

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☐ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

SIGNATURE of Applicant or Assignee of Record

Name	ROLF HARTUNG
Signature	R. Hartung
Date	6. May 2002

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☐ *Total of _____ forms are submitted.

#4

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☐ Declaration Submitted with Initial Filing OR ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	A34921 PCT USA
First Named Inventor	ROLF HARTUNG
COMPLETE IF KNOWN	
Application Number	10/030,532
Filing Date	JANUARY 9, 2002
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

HANDLING SYSTEM

(Title of the Invention)

the specification of which

☐ is attached hereto

OR

☑ was filed on (MM/DD/YYYY) 01/09/2002 as United States Application Number or PCT International Application Number 10/030,532 and was amended on (MM/DD/YYYY) _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	Certified Copy Attached? NO
199 32 063.2	Germany	07/12/1999	☐	☐	☑

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

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DECLARATION Utility or Design Patent Application

Claim for Benefit of Prior U.S. Provisional Application(s)

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

Provisional Application Number	Filing Date

Claim for Benefit of Earlier U.S./PCT Application(s) under 35 U.S.C. 120

(complete this part only if this is a divisional, continuation or C-I-P application)

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior application(s) in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose information as defined in Title 37, Code of Federal Regulations, Section 1.56 which occurred between the filing date of the prior applications(s) and the national or PCT international filing date of this application:

Application Number	Filing Date	Status (patented, pending, abandoned)

BAKER BOTTS LLP

Attorney Docket Number A34921 PCT USA

DECLARATION Utility or Design Patent Application

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

NAME OF SOLE OR FIRST INVENTOR : ☐ A petition has been filed for this unsigned inventor

1-00

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Family Name or Surname: HARTUNG

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NAME OF SECOND INVENTOR: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any]) | Family Name or Surname

Inventor's Signature | Date

Residence: City | State | Country | Citizenship

Mailing Address

City | State | ZIP | Country

☐ Additional inventors are being named on the ____supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.

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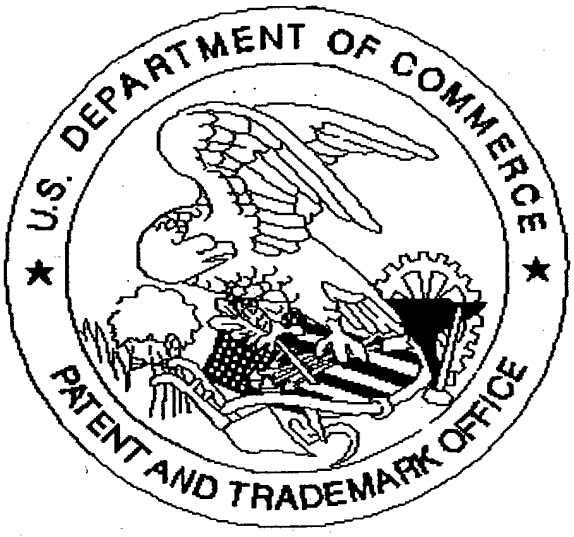

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